Social Variation and Dynamics in Metal Age and Protohistoric Central Thailand: A Regional Perspective

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INTRODUCTION

ARCHAEOLOGICAL RESEARCH IN THAILAND WAS ESTABLISHED HALF A CENTURY AGO and since then has made great strides in contributing to our understanding of the region's prehistory (e.g., Bayard 1980a, 1980b; Glover 1990; Gorman and Charoenwongsa 1976; Higham 1989; Higham and Kijngam 1984; Sorensen and Hatting 1967). In the past three decades, applications of most current frameworks and methodologies (e.g., studies of gender and social identities; economic production and exchange networks; and land uses and settlement patterns) (Bacus 2006; Bellina and Glover 2004; Boyd 2008; Ho 1992; Mudar 1995; Penny 1984; Theunissen et al. 2000; Vincent 2004; Welch 1985) have led to a growing awareness of regional variability and chronological distinctions between technological and sociocultural developments of the bronze and iron ages (Eyre 2006; Natapintu 2007; White and Hamilton 2009; White and Pigott 1996).

In the discussion to follow, the period of primary focus is the "Metal Age," the prehistoric period during which the metal technologies of bronze and later iron appeared in the region. In Thailand, the Metal Age precedes the appearance of protohistoric states and follows a period of unknown length, here termed "pre–Metal Age," when villages and plant cultivation developed along with ceramic and polished stone tool technologies. Despite attempts to argue that these technological transitions coincided with major social hierarchical transformations (Higham 1996:316, 2002:224–227, 2004:53–55; O'Reilly 2007:5, 2008:386), there does not appear to have been any overt, concomitant change in terms of sociopolitical elements of the kind that closely coincided with the appearance and development of metal technology in some parts of the Old World such as Mesopotamia and the central plain of China (e.g., Childe 1944; Heskel 1983; Muhly 1988).

Regardless of continuing debates surrounding Thailand's Metal Age chronological range and the role of metal technology, the Metal Age communities in

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Thailand underwent two major technological transitions and can be divided into two major periods: bronze age (c. 2000–600 B.C.) and iron age (c. 600 B.C.–A.D. 500) (Bacus 2006; Bronson and White 1992; White 2008; White and Hamilton 2009; cf. Higham and Higham 2008; Pigott and Ciarla 2007; Rispoli 2007). The use of the terms "bronze age" and "iron age" is intended to emphasize a technological sequence that existed irrespective of chronological controversies (Bacus 2006) or sociopolitical organization (White 2002).

It is argued here that the prevailing model of hierarchical sociopolitical organization, existing exclusively during the Metal Age and protohistoric period, is overly generalized. An alternative approach that incorporates underlying indispensable circumstances such as social variability and regional landscape is proposed to enrich our understanding of the development of social complexity in the region. The goal of this article is to explore a heterarchy framework that can be equally tested along with a hierarchical model. We summarize a recent intensive survey in central Thailand that encompasses several adjacent environmental zones and documents economic changes and shifting social networks over time. It is hoped that this investigation will generate debate and spur future investigations.

BEYOND HIERARCHY

Social Complexity in Metal Age Thailand

Developments of social complexity may have first emerged in northeast Thailand during the bronze age, as evidenced by variations of mortuary wealth and treatment at intra- and inter-site levels (O'Reilly 2003; Talbot 2007). Nevertheless, the characteristics are difficult to categorize or generalize beyond individual sites to a regional scale. Mortuary evidence at the sites of Ban Chiang, Ban Na Di, and Ban Lum Khao show subtle representation of marked status differentials supporting the interpretation that such communities could be characterized as small autonomous villages (Higham 2004; O'Reilly 2003; White 1995). The discovery of some relatively "wealthy" pre–Metal Age burials at Khok Phanom Di and bronze age burials at Ban Non Wat and Non Nok Tha (Bacus 2006; Higham 1996) indicates some form of social ranking (Higham 2002: 154–155, 159–160, 2008, 2009; O'Reilly 2003: 304–305) (Fig. 1).

The ambiguity extends well into the context of the bronze age economic systems. The dearth of hierarchical manifestation within the northeast and central Thailand landscape, in terms of organization forms with super- or subordination, is worth noting (Mudar 1995: 179; Welch and McNeill 1991: 213–214). Exotic artifacts commonly found at northeast and central Thailand sites represent a continuation of the long tradition of community participation in production, exchange and trade in the absence of centralized controlling elites (Bayard 1984; Higham 2002; White 1995; White and Pigott 1996). However, research questions in northeast Thailand have rarely deviated from a pursuit of the existence of hierarchy. Survey locations have been focused on areas conducive to wet-rice cultivation and, in turn, have discovered similar patterns of land use (Higham et al. 1982; Kijngam et al. 1980; Wilen 1987) (Fig. 2). The majority of settlements were less than five hectares and located on relatively elevated terrain adjacent to low-terrace soils in the middle courses of tributary streams. Based on these

Fig. 1. Map of important Metal Age sites in northeast and central Thailand.

limited locations, some scholars contend that the bronze age communities relied heavily on a wet-rice agricultural regime supplemented by wild fauna, accumulated wealth, and later developed hierarchical sociopolitical organizations (Higham 2002:225–227; Higham and Higham 2008:15; Higham and Thosarat 1998:127–128). Bronze Age settlements in northeast and central Thailand differ significantly in terms of site size and distribution relative to landscape. In central Thailand, an intensive survey in the Chao Phraya River Valley has challenged the universality of the wet-rice subsistence regime and has argued for consideration of variability in settlement systems (Mudar 1993, 1995). Bronze Age settlements were larger here than in northeast Thailand and occupied diverse environmental zones, mostly located on soils unsuitable for wet-rice cultivation (Fig. 2).

The hierarchical view has continued to dominate interpretations of Thailand's iron age sociopolitical development. Some scholars have argued that chiefdom levels of political organization emerged with the coming of iron based on evidence for differentiation of grave goods at sites such as Ban Don Ta Phet and Noen U-Loke (Glover 1990; Higham 2008; Talbot 2007) and changes in settle-

Fig. 2. Map of prehistoric site survey locations mentioned in the text, including the KSTUT.

ment patterns, including the presence of large sites with encircling earthworks near wet-rice-producing soils (e.g., Non Muang Kao) (Higham and Thosarat 2004, 2006; O'Reilly 2008). The emphasis on rank has undermined archaeologists' abilities to account for social variables and changes such as how burial representations reflect wider social relations, particularly how social groups attain and sustain power (De Lucia 2008; McGuire and Saitta 1996). Evidence for power and wealth deflation is downplayed. For example, Ban Non Wat, where Higham and Higham (2008) suggest there is evidence of social ranking during the bronze age, seems to lack differentiation of wealth in subsequent iron age burials. "The [late Bronze Age] burials are markedly poorer in terms of mortuary wealth, and bronzes are very rare . . . BA 5 developed seamlessly into the early Iron Age . . . it is only on the basis of the presence of iron artifacts that on occasion one can distinguish the two . . ." (Higham and Higham 2008:7–8).

Current regional understandings, in northeast and central Thailand, do not support generalized correlations of the appearance of iron technology with the emergence of hierarchical settlement systems as is expected with chiefdoms and states. In central Thailand, the presence of large bronze age sites, continually occupied into the iron age, often occur in uplands outside of areas where wet rice can be grown (Kanjanajuntorn 2005; Mudar 1995; Onsuwan 2003). A phenomenon of long gradual growth in settlement patterns, without abrupt change, was also witnessed in the Phimai region of northeast Thailand where intensive regional exchanges and two levels of economic hierarchy occurred around mid– iron age (200 B.C.–A.D. 300) (McNeill and Welch 1991). Many constructions of encircling earthworks in this area have been argued to have addressed water availability concerns rather than to serve political purposes (Boyd 2008; McGrath et al. 2008). Here such changes occurred around the mid– to late iron age (A.D. 0–600) and preceded any clear evidence for political centralization and the emergence of states.

Applications of Heterarchy: Methodological Refinement

More complex and unequal societies have long been equated with hierarchical models of chiefdoms and states. These neo-evolutionary models sought the presence of power concentration and decision-making in a small group of elites and progressive centralization of social, economic, and political life (Flannery 1972; Friedman and Rowlands 1977; Service 1971). Over the years, scholars have argued that many forms of power relations exist within and between groups and therefore they cannot be reduced to a vertical hierarchical structure (Brumfiel 1995; Chapman 2003; Flanagan 1989; McGuire 1996; Possehl 1998; Stein 1998). To complement hierarchy, the concept of heterarchy was developed to take into account various contexts of social networks where power relations were negotiated and articulated (Crumley 1995; Ehrenreich et al. 1995; R. McIntosh 2005; S. McIntosh 1999). Heterarchy is a state where social elements have the possibility to be ranked in various ways or to relate in equal positions of authoritative power, and where power relationships between individuals and groups may change depending on the social context.

My research proposed to test for the presence of hierarchical and heterarchical sociopolitical frameworks for best fit with data recovered from the settlement pattern study I conducted in the Eastern Chao Phraya River Valley. The current debate regarding social complexity during Thailand's Metal Age focuses primarily on mortuary evidence. New lines of evidence are required to expand the debate and, thus, there is a need for innovative research that critically assesses monolithic models and implements broader regional research designs (Kealhofer and Grave 2008; Stark 2006). Settlement pattern studies allow archaeologists to articulate dynamic relationships among sites at local and regional levels, which is often not possible through excavations alone (e.g., Billman and Feinman 1999; Holdaway and Fanning 2008; Marcus and Flannery 1996; Sinopoli 2006; Underhill et al. 2008).

Hierarchy and heterarchy are not mutually exclusive. A heterarchy may contain hierarchies, or some levels of hierarchy may include heterarchical groups (Roosevelt 1999; Scarborough et al. 2003). The correlates of a heterarchy were developed after White's model (1995: 104) characterized Thailand's Metal Age sociopolitical organization as having flexible hierarchy, lateral integration, and decentralized regional economic differentiation. Political hierarchical systems often manifest in pyramidal networks where power is concentrated and maintained at the highest levels of the structure. Evidence to support hierarchical settlement models might find trends toward tiered site hierarchies, centralized organization, and evidence of some sites having strategic control over resources (Peebles and Kus 1977). The larger settlements would serve as a central node for collection and distribution of goods; sites of lower rank could be evenly spaced around higher-ranking ones in nested hexagonal lattices (Earle 1987; Friedman and Rowlands 1977; Wright 1986). As for this research, the absence or presence of hierarchical settlement patterns is not sufficient alone to evaluate social complexity. Our research goal is to characterize local economic interactions in light of the uncovered settlement patterns.

In the context of central Thailand, two factors are proposed as key underlying economic components of a heterarchical system. Evidence of long-term diversified settlement systems ranging from uplands to lowlands is indicative of ranges of independent resources for Metal Age communities (Ho 1992; Mudar 1993; Mudar and Pigott 2003). A diversified subsistence economy is argued to have allowed prehistoric societies to take advantage of a broad range of environmental zones, which enhanced political flexibility, stability, and longevity. In this type of regional economy, it is proposed that sociopolitically independent groups could connect freely to other groups without permission from a center. In general, inequalities probably existed within and between groups based on unevenly distributed resources within the landscape, but evidence for relationships where one group dominated another through military or economic means has only been suggested at the iron age site of Noen U-Loke during the final mortuary phase (c. A.D. 400) (Higham 2007:606; O'Reilly 2008:384). The absence of direct control over important resources such as metal ores and relatively low bone trauma have been argued to show low levels of centralized control and violence during the Metal Age in Thailand (Bentley et al. 2009; White 1995; White and Pigott 1996).

In addition, the analysis of Metal Age ceramic variability (Rice 1981), defined in this research as *ceramic subregion* based on regional groups of stylistic similarities (Ho 1992; Lertrit 2003b; Rispoli 1997; Welch and McNeill 1991), could serve as a second indicator of sociopolitical organization. Local socioeconomic networks (e.g., producer-consumer, kinship, and alliance) might be equated with these shared ceramic groupings (Dietler and Herbich 1998; Nelson and Habicht-Mauche 2006). The subregion could be characterized as a decentralized community-based organization made up of multi-center economies in which multiple production nodes occurred in settlements which engaged in production and exchange to varying degrees (Stark and Heidke 1998). Flexibility of these production and exchange networks, observed by changes over time, could indicate that power was negotiated and redistributed according to relationships among communities. It is also possible that such decentralized community organizations could be components of a larger hierarchical system (Costin and Hagstrum 1995; Potter and King 1995).

In sum, five possible expectations would be consistent with a settlement system that had strong heterarchical dynamics (Onsuwan 2003): (1) cultural pluralism could be identified in the form of subregional ceramic variation, possibly suggesting differentiation in local socioeconomic networks; (2) ceramic subregions would not necessarily coincide with distinct environmental zones, indicating that local communities may engage in multiple subsistence adaptations; (3) ceramic subregions endured, perhaps shifting over time, suggesting that local organizations remained flexible and adaptive in maintaining their location within proximity despite changes within the landscape; (4) differentiation of site size would not be limited to lands favorable to wet-rice cultivation, which would suggest that population aggregation was not necessarily tied to only the most highly productive subsistence regime; and (5) evidence for economic specialization would occur at various site sizes and types, suggesting that specialized communities may be dispersed throughout the settlement system and not controlled by centers.

KOK SAMRONG–TAKHLI UNDULATING TERRAIN (KSTUT): INTENSIVE SURVEY

KSTUT Environment

Central Thailand encompasses subequatorial and subtropical environments and is known for its diverse regional variability in climate and vegetation (Kealhofer 1997, 2003; White et al. 2004). General regional environmental changes have been derived from studies on the impact of sea level changes to ancient coastlines (Horton at al. 2005; Sinsakul 2000; Tija 1996). The regional climate became cooler and drier during the Last Glacial Maximum and additional changes occurred during the Holocene when sea levels rose and fluctuated and reached a maximum height of 4 m above mean sea level around 6000 years B.P. before settling at its present level c. 1500 years B.P.

The survey region is located within the lower part of the Northern Basin, of the Eastern Chao Phraya River Valley. The survey area called the *Kok Samrong-Takhli Undulating Terrain* (KSTUT) was chosen because it encompasses a variety of landscapes, and includes two excavated sites of Ban Mai Chaimongkol (BMC) (Eyre 2006; Natapintu 1996, 2007), a Metal Age site; and Chansen (CH), a late Metal Age and protohistoric site (Bronson 1976) (Figs. 2 and 3). KSTUT is a distinctive microregion that lies along northwest-southeast oriented undulating terrain within the two administrative districts of Kok Samrong, Lopburi province and Takhli, Nakhon Sawan province (Natapintu 1997: 49–50). To the north, it was bounded by the flat terrain around the great swamp of Bung Boraped, to the south by the alluvial plains along the upper tributaries of the Lopburi River, to the west by the relatively flat alluvial plain extending from the left bank of the Chao Phraya River, and to the east by small streams at the base of a chain of mountains.

KSTUT is characterized by undulating terrain ranging from 50 to 150 masl and a series of floodplains, semi-recent terraces, marl terraces, small hills, and mountains (Thai Land Development Department 1987; Thiramongkol 1983). The survey region encompasses three major environmental zones: alluvial plain, middle terrace, and uplands. The water systems consist mainly of springs, ponds, swamps, and small streams, and the majority of the streams originate from natural springs (Natapintu 1997: 50). Takaya (1987: 98–99) loosely defined the area as non-lateritic, with fairly fertile soil—the *Lopburi Grumosol Area*. Most of the *Lopburi Grumosol Area* is not suitable for wet-rice agriculture for several reasons: high

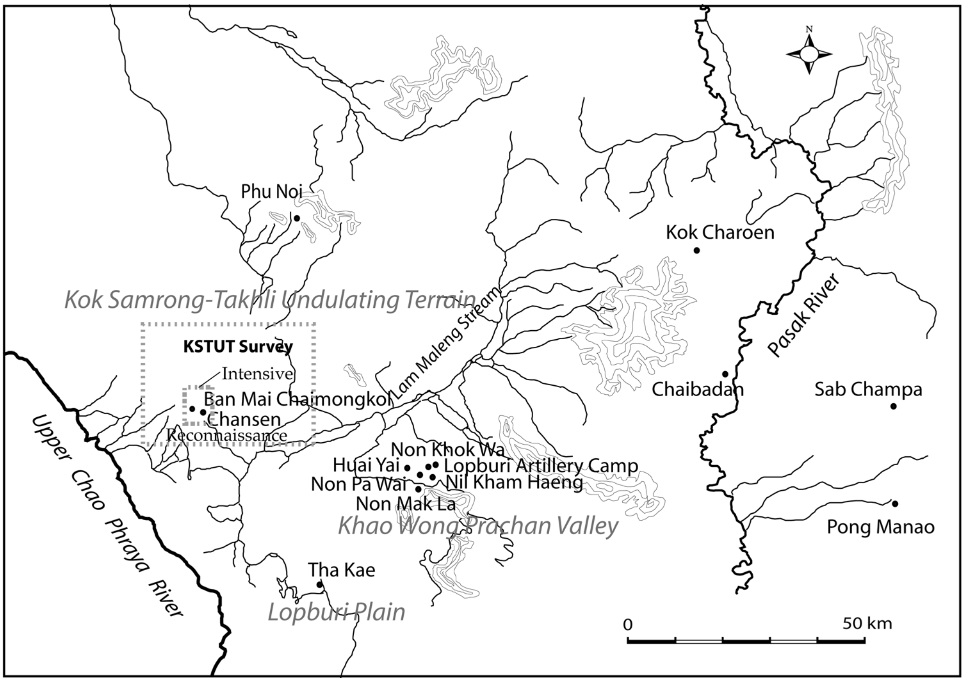

Fig. 3. Excavated prehistoric sites of inland central Thailand: Eastern Chao Phraya and Pasak River Valleys.

slope, water deficiency, and the lack of clayey soil components (Mudar 1993 : 27; Takaya 1987 : 11). Higher and lower elevations of *Lopburi Grumosol* soil are more suitable for field crops, however, one can still practice wet-rice cultivation in the lowlands.

The present KSTUT patterns of land use illustrate how geomorphology, topography, and soil types have played significant roles in determining types of cultivation in the region (Thai Land Development Department 1987). The KSTUT growing season is dictated by the rainy season. Locals utilize a variety of cultivation practices; wet-rice agriculture is not the only or main type of cultivation. The alluvial plain and middle terrace are characterized by three soil types: *Lopburi Low Phase* and *Ban Mi* have good water retention and are suitable for wet-rice cultivation; *Lop Buri* has medium porosity and is suitable for field crops. Mixed cultivation of both wet-rice and garden crops is found on the alluvial plain where there is relatively flat terrain and high water retention. The lower middle terrace predominantly grows wet rice, but at the higher elevations these terraces do not experience flooding and only field crops are grown. The uplands are dominated by *Takhli* soil, originating from decomposition of marl, which is fertile but has poor water retention. Upland villagers only cultivate field crops.

Regional Background

Within the KSTUT, large numbers of prehistoric sites have demonstrated its importance for understanding long term habitation of central Thailand. The KSTUT reconnaissance survey documented up to 32 sites (Onsuwan 2003); the Lopburi Survey recovered 50 sites (Ho 1992); the Nakhon Sawan Survey recorded 55 sites (Natapintu 1997); and, the Lam Maleng intensive survey located more than 100 sites (Mudar 1993) (Fig. 2). Shared ceramic styles and metal artifacts among many KSTUT sites (Ho 1992; Mudar 1993; Natapintu 1997; Rispoli 1997) and its neighbors including Tha Kae (a late Metal Age and protohistoric site in the Lopburi Plain; Ciarla 1992), and sites of the Khao Wong Phrachan Valley (KWPV) (Pigott et al. 1997), strongly indicate prehistoric development of socioeconomic subregional networks (Fig. 3). Excavations at KWPV documented economic differentiation on an industrial scale involving metal production that developed prior to the appearance of states or any regional evidence of centralization (Natapintu 1997; Pigott and Ciarla 2007; Pigott et al. 1997). After three millennia of human use, c. A.D. 500 the region saw the emergence of the Dvaravati civilization, as evidenced, for example, at the moated site of Chansen (Bronson 1976; Indrawooth 1999; Vallibhotama 1996). While relatively small compared to other moated Dvaravati sites in central Thailand (e.g., U-Thong, Nakhon Pathom, and Ku Bua), the importance of Chansen is its location among numerous documented Metal Age sites as well as the fact that it has been systematically excavated.

The objective of the 2001–2002 KSTUT Survey reported here was to more thoroughly examine the land use/settlement change over time in an area known to be occupied throughout the Metal Age and protohistoric periods. Did the settlement system change in concert with metals-related technological change, as has been posited by some (Higham 1996, 2002, 2004; O'Reilly 2007, 2008), and if so, when and how did it change?

Survey Methodologies in Thailand

A review of nine surveys of prehistoric sites conducted in Thailand–including three reconnaissance surveys (Ho 1992; Lertrit 2003*a*, *b*; Thai Fine Arts Department 1988), five systematic surveys (Higham et al. 1982; Kijngam et al. 1980; Penny 1986; Shoocongdej 2003; Welch and McNeill 1991; Wilen 1987), and one intensive survey (Mudar 1995)–provided the basis for the development of KSTUT survey methodology and demonstrated some of the limitations involved in previous settlement pattern studies in the region (Table 1 and Fig. 2). All of the five Metal Age and protohistoric surveys in Thailand, including Sakon Nakhon and Khorat Basin (Higham et al. 1982; Kijngam et al. 1980), Huay Sai Khao Basin (Wilen 1987), Phimai (Welch 1985), and Lam Maleng (Mudar 1993) surveys employed a hierarchical framework. Focusing on alluvial plains, surveys in Sakon Nakhon, Khorat, and Huay Sai Khao Basins had inbuilt biases. Approximately 80 small Metal Age settlements, ranging from 0.6 to 10 ha, lack clear evidence of site hierarchy. Large and moated sites in the Khorat Basin were argued to develop after 400 B.C. (Higham et al. 1982:23; Kijngam et al. 1980:69–70). Although the investigators emphasized finding lowland sites, there are some indications of settlements located in the middle and high terraces (Higham et al. 1982:5, 7; Wilen 1987:109–110).

Systematic exploration of diverse landscapes is a breakthrough methodology in Thailand settlement pattern studies. The Phimai Survey (Welch 1985; Welch and McNeill 1991) employed rigorous methodology incorporating local interviews,

Table 1. Comparison of Archaeological Site Survey Methodologies Conducted in Thailand

Survey project	Framework	Sampling design	Systematic research design	Villager interview	Foot survey	Data collection	Land use data	Environmental diversity	Survey area (km2)	Uncovered site/density (/km2)
Nakhon Sawan (Thai Fine Arts Department 1988)	locate sites	no	no	yes	partially	site location & condition, no systematic sherd collection	yes	diverse	9,598	31/0.003
Lopburi (Ho 1992)	locate sites	no	no	yes	not available	site location, water sources, no systematic sherd collection	yes	diverse	8,000	50/0.006
Pasak River Valley (Lertrit 2003a, 2003b)	locate sites	no	no	yes	not available	site location, no systematic sherd colllection	not available	not available	not available	14+/not available
Sakon Nakhon & Khorat Basins (Higham et al. 1982; Kijngam et al. 1980)	Hierarchy & settlement patterns	no	yes	yes	partially	site location, size, water sources, no systematic sherd collection	no	minimal/ only soil suitable for rice cultivation	1,800	120/0.07
Huay Sai Khao Basin (Wilen 1987)	Hierarchy & locate sites	no	yes	yes	partially	site location, no systematic sherd collection, site size	no	minimal/ only soil suitable for rice cultivation	800	25/0.03

(Continued)

Mae Hongson Highland Project (Shoocongdej 2003)	study social developments	no	yes	yes	yes	site location, size, function, no sys-tematic sherd collection	not available	diverse	1,000	54/0.052
Petchabun (Penny 1984, 1986)	locate transitional period sites from Hoabinhian	transect	yes	yes	minimal	site location, size, no systematic sherd collecton	no	diverse	1,100	45/0.04
Phimai (Welch 1985)	study social developments	transect	yes	yes	at & around sites	site location, size, function, systematic sherd collection & maps	yes	diverse	700	107/0.15
Lam Maleng (Mudar 1993, 1995)	Hierarchy & settlement patterns	intensive	yes	yes	yes	site location, size, function, systematic sherd collection & maps	yes	diverse	60	105/1.68 (intensive)
KSTUT (Eyre 2006)	Heterarchy & settlement patterns	intensive	yes	yes	yes	site location, size, function, landscape, systematic sherd collection & maps	yes	diverse	58	25 +7 caves/0.43 (intensive)

foot survey at and around sites, systematic artifact collection, measurement of sites and the use of aerial photographs. Over 100 sites were recorded, the majority of which began c. 1000–600 B.C. and were argued to have depended on wet-rice agriculture. While intensive forms of agriculture developed and settlements expanded into the terrace and upland zones at the beginning of the iron age (c. 600 B.C.), two-level hierarchical settlement systems including many large and moated settlements did not develop until c. 200 B.C.–A.D. 300. During the protohistoric period, most of these sites were abandoned and the new settlement system was comprised of a few large sites surrounded by smaller villages. In central Thailand, Lam Maleng Survey, the first intensive survey conducted in mainland Southeast Asia (Mudar 1993, 1995), established systematic transects to record and to collect artifacts, and uncovered 105 sites across diverse terrain. Lam Maleng's Metal Age settlement patterns, in contrast to Phimai, exhibited extensive and long-term use of the uplands where dryland farming was thought to have been practiced. Changes in settlement locations to wet-rice-producing areas occurred possibly after A.D. 500. While rank-size analysis showed no clear evidence of site hierarchy, findings of growing regional integration over time is consistent with Phimai.

The fact that none of the surveys found clear evidence that the development of settlement hierarchy coincided with the early use of metals in Thailand highlights the importance of implementing alternative frameworks incorporating heterarchy. A number of effective methodologies were incorporated in the KSTUT Survey: establishing a survey region that encompasses a variety of landscapes; combining extensive local interviews with systematic foot survey in all landscapes; striving for comprehensive awareness of the characteristics of each environmental zone; and employing systematic data collection in all areas (Mudar 1993; Welch 1985; Welch and McNeill 1991).

KSTUT Intensive Survey

Intensive survey with full coverage pedestrian design was needed to address previous research biases and as a result the KSTUT Survey was designed and implemented in 2001–2002. Our team conducted an intensive survey covering an area of 58 sq km, incorporating in its methodology many aspects of the Lam Maleng Survey which was conducted about 30 km to the east (Mudar 1993). In particular, we utilized Mudar's two-stage approach of a reconnaissance survey of a larger study area followed by 100 percent survey of a selected sample area (Fig. 3). First, a reconnaissance survey of an area of 1000 sq km was conducted to evaluate preliminary site distributions, aided by information from local interviews. This survey region was chosen to encompass lowland, terrace, and upland zones and covered two excavated sites of BMC and CH. Despite extensive literature on the problem of relating surface size to site size, particularly in agricultural fields (e.g., Banning 2002), the large number of sites and the dense concentration of artifacts documented in the survey region suggest that deep plowing and flooding did not compromise the integrity of sites in the area. Sites were defined, following Mudar's successful approach, based on artifact density or concentration rather than on size of the area or the number of sherds (1993:85).

This was followed by an intensive foot survey encompassing three environmental zones: 14 sq. km of alluvial plain, 20 sq. km of middle terrace, and 24 sq. km of uplands. Several enhancements to the Lam Maleng Survey methodology were utilized in terms of site recording and pottery sample collection procedures resulting from heterarchical theoretical models. First, the KSTUT Survey boundary was not defined by major water sources as was the Lam Maleng Survey. Second, the acquisition of information regarding current land use and land use history through interviews with local villagers represented a key source of KSTUT Survey data. Third, the surveyors collected evidence for settlement distribution as well as evidence from each site including not only site size, but also surface features, surface artifacts, observable site formation processes, environmental variation and site function.

In order to locate sites, the KSTUT team walked across the landscape in transects with four or five members approximately 15–25 m apart. Once a site was identified, it was assigned a site name, and a global positioning system allowed for more efficient location on maps. A transect-and-collection-at-nodes method was used to retrieve a systematic, not just representative, sample of artifacts across entire sites and to determine site size. Site boundaries were defined by the absence of artifacts at more than five nodes, about 100–150 m. Rakes and hoes were used to clear the ground of leaf detritus to ensure that no artifacts were missed at nodes. Finally, a wide range of sample diagnostic and non-diagnostic sherds were systematically collected at nodes and evidence of production activities and trade were explicitly sought.

Careful planning was employed to take advantage of the intensive modern day double cropping seasons that contributed to a high visibility survey area (Mudar 1993:83–85). The earliest harvest season of the year begins around mid-December in the lowlands when rice, corn, and garden crops are harvested. The window of opportunity for surveying lowland areas is brief as villagers start to plant rice again by mid-March, at which time the entire cultivated area must be flooded. In the uplands and middle terrace, the harvest season begins around the end of February for corn, sugarcane, pumpkin, and millet. The intensive survey began early in January in the lowlands and, by the time the lowland survey was completed in mid-February, the upland and middle terrace fields had been cleared. Although replanting of the middle terrace and uplands occurs at the beginning of the rainy season around April/May, it is possible to continue surveying until the crops grow high enough to make the area impenetrable.

Integrated Chronology

Prior to the KSTUT Survey, the first integrated chronology of prehistoric inland central Thailand was developed (Eyre 2006). The KSTUT chronology is based primarily on stratigraphic analysis of ceramics from the two excavated sites with overlapping chronologies of Ban Mai Chaimongkol (BMC) (Natapintu 1996; Onsuwan 2000) and Chansen (CH) (Bronson 1976), both located within the survey boundary (Fig. 3). BMC chronology was constructed from over 80 whole mortuary vessels based on relative sequences of intercutting of graves and habitation activities (Onsuwan 2000); it extends from the late third millennium B.C. to the Upper Iron Phase (ending c. 400 B.C.). Chansen chronology was constructed based on the stratigraphic position of ceramic types and absolute dates; it starts in the Lower Iron Phase (c. 600 B.C.) and lasts until the late protohistoric Dvaravati period (c. A.D. 900). In addition, the reliability of the proposed chronology was established through cross-dating with ten other nearby archaeological sites, e.g., Phu Noi (PN), those in the KWPV (e.g., sites of Non Pa Wai, Nil Kham Haeng, and Huai Yai), Tha Kae (TK), Kok Charoen (KC), Sab Champa (SC), Chaibadan (CBD), Ban Pong Manao (PMN), and Ban Kao (BK) (Ciarla 1992; Ho 1984; Lertrit 2003*a*, *b*; Natapintu 1997, 2003; Pigott et al. 1997; Rispoli 1997; Sørenson and Hatting 1967; Veraprasert 1982). Despite limited availability of absolute dates, attempts were made to relate the relative integrated chronology to the available absolute dates (Table 2). Future research will inevitably revise this working chronology.

The adequately refined KSTUT ceramic sequence provides a structure for documenting long-term uses of the area and the potential means for identifying ceramic subregions. The survey chronology spans five Metal Age Phases; sixteen vessel forms and key-time specific diagnostic attributes of rim forms and surface decorations have been defined as a comprehensive ceramic chronological index. Key diagnostic decorations include: thick red burnished slip, red painted ware, and incised lines filled with impressed or incised motifs and reserved decorations (i&i) for Lower Bronze Phase; incised executed geometric design with pricked design and i&i for Middle Bronze Phase; incised hanging and standing triangles, and complex diagonal incised lines on pedestal for Upper Bronze Phase; red paint inside channel, applied or incised fillet on neck for Lower Iron Phase; flange, and band of wavy incised design for Upper Iron Phase.

KSTUT SURVEY FINDINGS

KSTUT data collection was designed specifically to take into account multifaceted information. Broad ranges of data consisting of settlement pattern and land use, evidence of ceramic subregion, and other kinds of craft specialization are explored below. It became obvious, during the course of the analysis, that each type of data is not without limitation and therefore has to be interpreted in the contexts of one another.

Settlement Pattern and Land Use

KSTUT Survey uncovered 25 open-air sites in all three landscape zones—alluvial plain, middle terrace, and uplands, with additional 7 cave sites located on a hill adjacent to the uplands. The total area of occupation for all time periods excluding the cave sites is approximately 255 ha. Twenty-three open-air and two cave sites are multi-component. While such long continuous use of most KSTUT Survey sites is significant for understanding prehistoric settlement systems, it hinders the KSTUT Survey methodology in determining how site size changed through time. Each site's maximum size was estimated based on the total dimensions of pre- and protohistoric cultural remains recorded at the time of survey. Nevertheless, four characteristics of the KSTUT settlement pattern can be drawn to facili-

Table 2. Integrated Regional Chronology of Inland Central Thailand

Estimated Dates[1]	Period	Phases	Eastern Chao Phraya River Valley							Pasak River Valley			Kwai River Valley
			Kok Samrong-Takli Undulating Terrain			Khao Wong Prachan Valley			Lopburi Plain				
			BMC[4]	CH[6]	PN	NPW	NKH	HY	TK[7]	KC	SC	CBD	BK
900													
800													
700	Proto-historic	Dvaravati		Phase V							Dvaravati		
600									Layer 2a				
500				Phases III & IV									
400													
300						Period 3			Layer 2b			Layer 2	
200		Late Iron		Phase II									
AD 100													
1									Layer 2c		Iron	Layer 3	
100 BC													
200	Iron			Phase Ib				Phase 2					
300													
400		Upper & Lower Iron				hiatus							Iron Age
500			UI & LI	Phase I									
600							Period 2		hiatus		Late Bronze		
700					Upper, Middle & Lower Levels[5]								
800		Upper Bronze	UB										
900							Period 1						
1000													
1100						Period 2							
1200										Mortuary Phases 2 & 3			
1300													
1400	Bronze	Middle Bronze	MB		Possible Occupation[2]				Layer 3				
1500													Neolithic Late
1600													
1700						hiatus							
1800													
1900									Layer 4	Mortuary Phase 1			
2000								Phase 1					
2100		Lower Bronze & Initial	LB										Neolithic Early
2200						Period 1			Layer 5		SC II[8]		
2300	Initial[3]												
2400													
2500													

[1] these estimated dates are based on the absolute datings
[2] Rispoli (1997) and Surapol (1997) based on the presence of surface finds of SPID, TRBS, and incised zig-zag decorations
[3] see discussion of this hypothetical phase in Eyre 2006
[4] Onsuwan (2000); [5] data is based on excavation in 1984 (Natapintu 1997)
[6] Bronson (1976); [7] chronology is based on Ciarla (1992), although some information came from FAD excavations
[8] The first SC excavation has 3 locales; SC II is the only one used in this analysis (Ho 1984)
bold = estimated dates from absolute datings (Bronson 1976; Ho 1984; Sørenson and Hatting 1967; Bronson and White 1992)

tate temporal and spatial discussions: long duration, diversification, and variability in function and size.

Long Duration and Diversification

The KSTUT settlements, throughout the Metal Age until the Late Iron Phase, continually exploited diverse landscapes. Bronze Age settlements occupying the upland and middle terrace areas are more numerous than those found on the alluvial plain (Fig. 4). Fourteen upland and middle terrace sites and two alluvial plain sites contain initial/Lower Bronze Phase evidence (c. 2000–1700 B.C.) and most of these occupations continued into the Middle (c. 1700–1000 B.C.) and Upper (c. 1000–600 B.C.) Bronze Phases. There are no marked changes in the settlement patterns from the Bronze period to the early Iron Phases (c. 600 B.C.–A.D. 100). The evidence indicates a long-term diversified subsistence system with a slightly increased interest in middle terrace and alluvial plain occupation and no new settlement in the uplands. The process of depopulation of the uplands appears to have begun during the Late Iron Phase (c. A.D. 1–400), as the number of upland sites decreased at the same time that the number of lowland sites increased. Major changes in land use took place during the protohistoric period, c. A.D. 400, when settlements became restricted to lowland areas. No protohistoric upland sites were identified and the total number of occupations in the surveyed area declined from 22 in the iron age to 8 sites during the protohistoric period (Fig. 5). These 8 protohistoric sites represented continuations of Metal Age communities but were located within the alluvial plain and only one portion of the middle terrace zone.

Analysis of the KSTUT four major soil types in correlation with site size differentiation illustrates complexity in the KSTUT subsistence systems that put low emphasis on wet-rice-producing soil (Fig. 6). A larger and higher number of sites occupied areas where lands are unfavorable to wet rice cultivation. Only half of the alluvial plain sites (BMC, DM, NKA) are located on *Lop Buri low phase* soil and five out of twelve middle terrace sites are located in *Ban Mi* soil. Both soil types are suitable for wet-rice agriculture and the majority of these sites were occupied into the protohistoric period. The rest of the alluvial plain sites (BMA, BKL, and the largest site of Chansen) and seven middle terrace sites occupied *Lop Buri* soil, which is very fertile but not suitable for wet-rice agriculture because it is on higher ground. All seven upland sites are located on high marl *Takhli* soil, very fertile and suitable for field crops.

Further assessment of environment and surrounding landscape features including the Holocene palaeoenvironmental contexts, landforms, slopes, and water resources in light of these diversified patterns indicates that the KSTUT settlements had access to particularly fertile soil and abundant resources of complex mixed deciduous forest (Kealhofer 1997) that would have encouraged long-term settlement and independent socioeconomic systems. Although the sea level of the historic Bay of Bangkok never extended as far inland as the KSTUT area, its fluctuations during the Holocene might have had an impact on these prehistoric settlement patterns and economic systems, especially regarding the availability of marine resources. Chansen is currently about 200 km from the Bay of Bangkok. At its maximum level, the sea may have come as close as approximately 50–100 km from the alluvial sites in the KSTUT Survey area (Cremaschi et al. 1992;

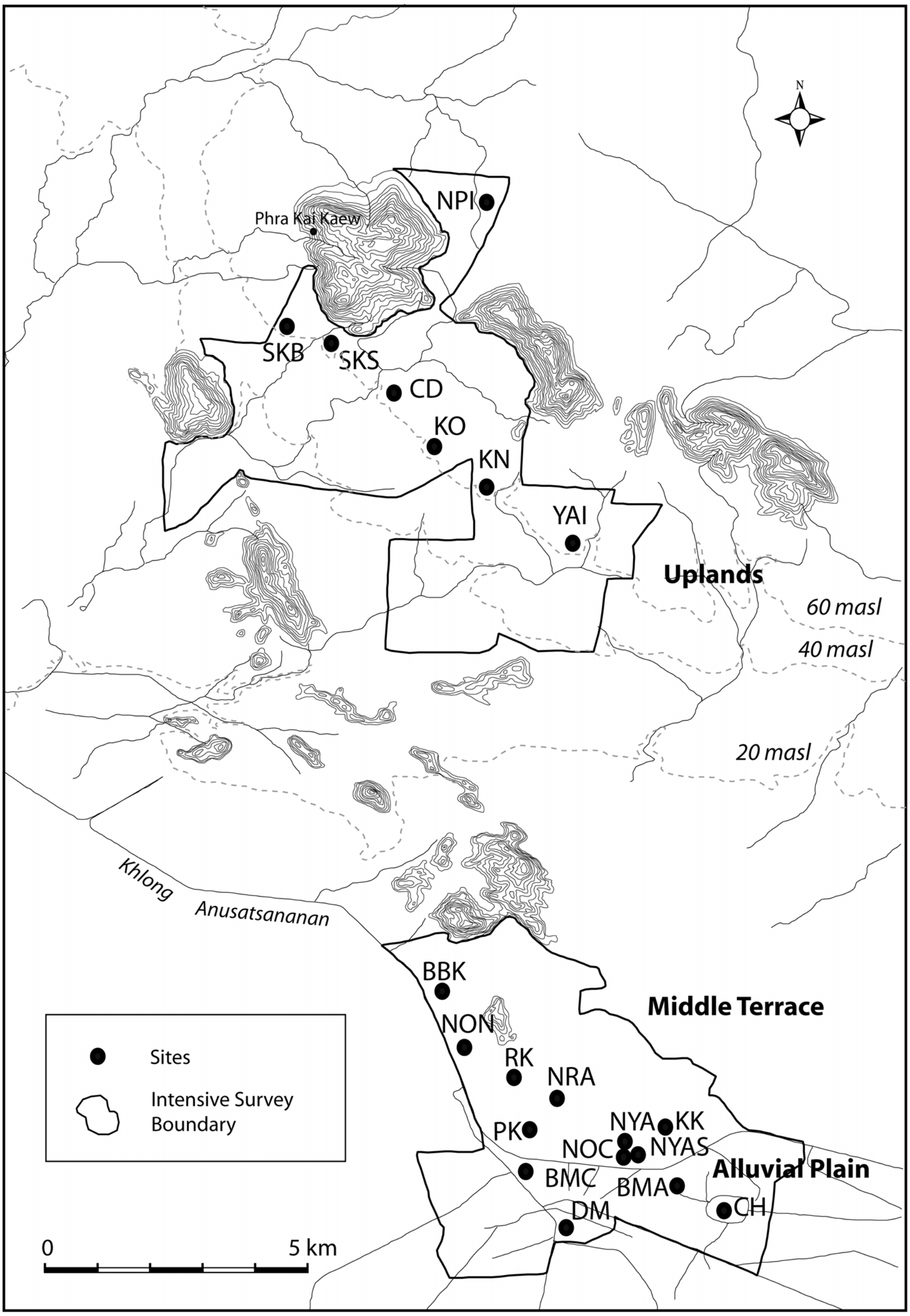

Fig. 4. KSTUT site distributions during the Upper Bronze phase.

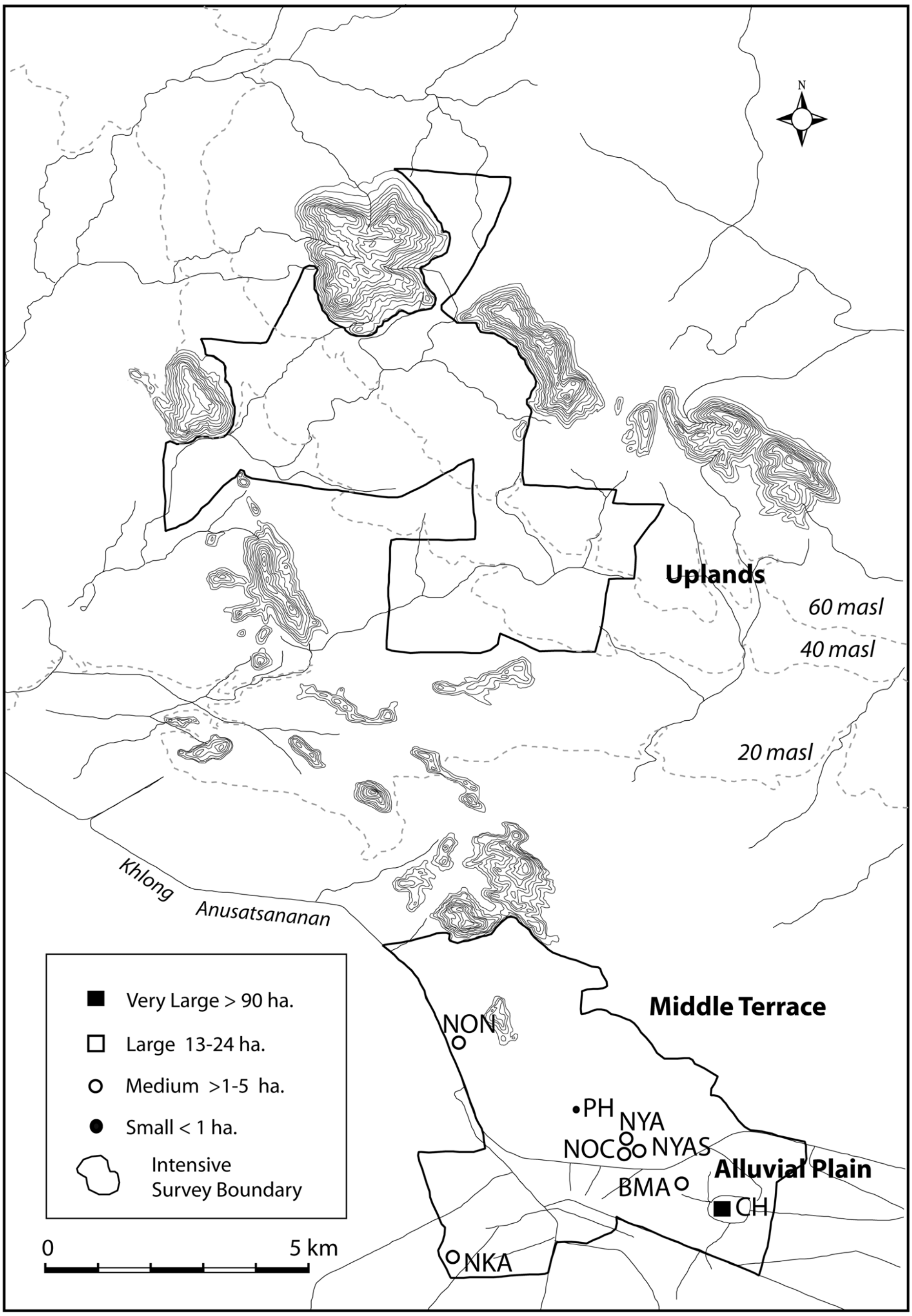

Fig. 5. KSTUT Protohistoric site sizes and distributions.

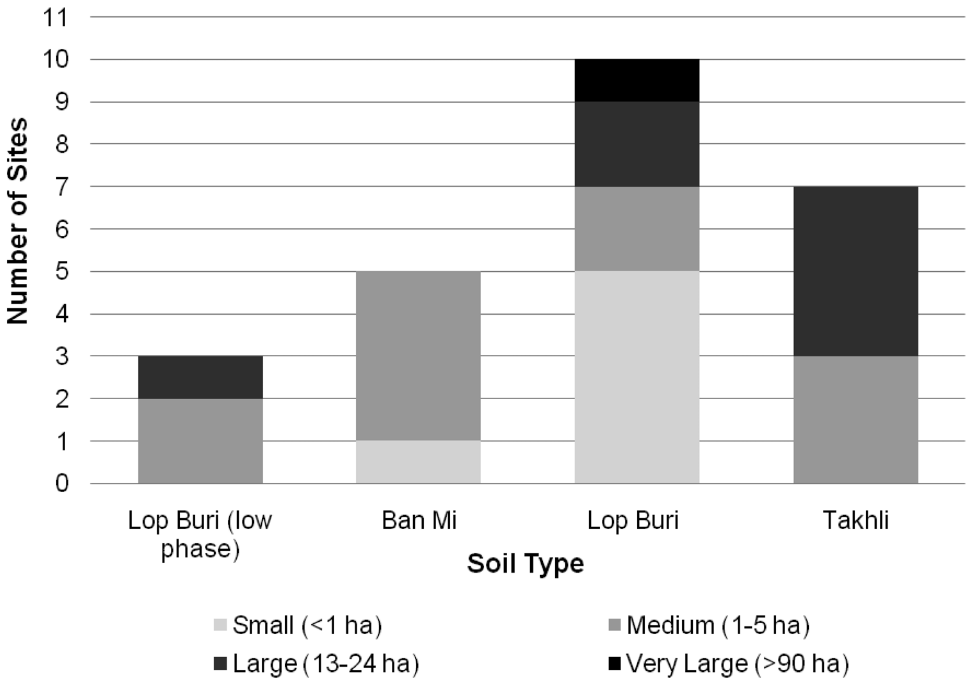

Fig. 6. Chart of site size stratified by soil type indicating that KSTUT site differentiation was not limited to lands favorable to wet-rice cultivation.

Sinsakul 2000:416, 421). Localized impact of such environmental changes to ancient societies merits further investigation.

Various Functions and Sizes

Evidence of KSTUT settlement types and cluster of site distribution patterns augment examination of the complexity of the settlement systems. Two main functions—primarily habitation and mixed mortuary and habitation—are documented across the landscape where both site types are evenly dispersed. Of the 23 multi-component open-air sites, 12 have evidence for mortuary use and have long sequences. Two types of site sizes are associated with these mortuary uses: medium (five sites) and large or very large (seven sites). Interestingly, these large sites often have access to perennial water sources. Eleven of mortuary/occupation sites have earliest evidence since the Lower Bronze Phase; only one site (CH) has evidence of mortuary/occupation since the Middle Bronze Phase (it is possible that CH Lower Bronze deposit has been deeply buried by subsequent occupation). Two mortuary/occupation sites remained until the Upper Iron Phase; seven lasted until the Late Iron Phase, and three continued until the protohistoric period.

The KSTUT site size range is from 0.04 to 91.5 ha and sites can be grouped into small, medium, large, and very large (Fig. 7). The smallest site is located in the middle terrace and the largest site (Chansen) is situated in the alluvial plain.

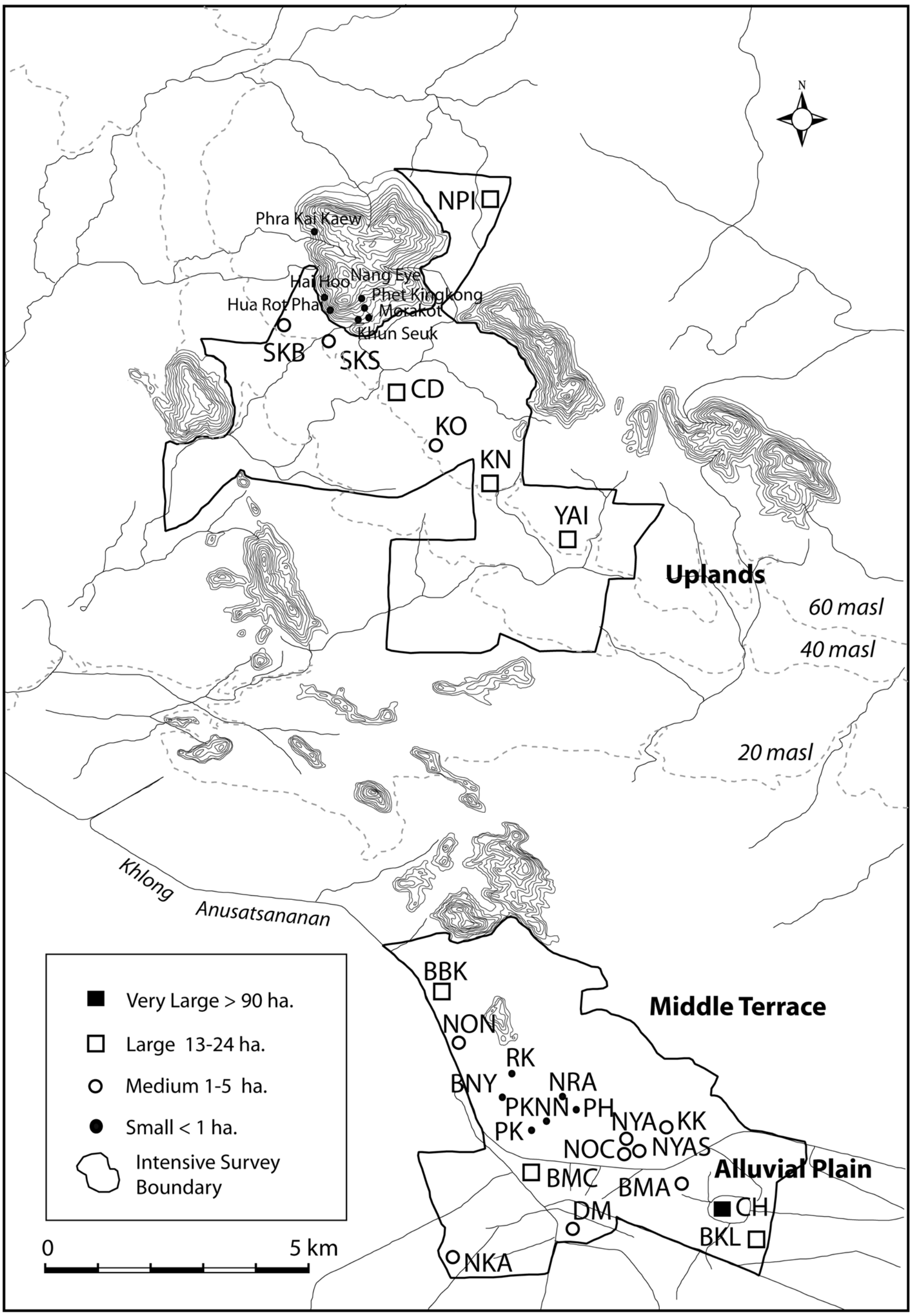

Fig. 7. KSTUT site size and distributions: 25 open-air sites and 7 cave sites were uncovered in the alluvial plain, middle terrace, and uplands. All open-air sites had evidence of both bronze and iron age occupation (except BKL and PKNN sites).

The Metal Age settlement patterns are comprised of small, medium, and large sites dispersed across all environmental zones. Large sites seem to characterize the uplands with four out of seven open-air sites ranging between 14 and 24 ha; the remaining three are medium-sized. Given the uniformity of the survey methodology, it is indisputable that the uplands had enduring Metal Age occupations (Eyre 2006:237–250, 278–287). Small and medium sites characterize the middle terrace; five out of twelve sites range between 1 and 5 ha, and six out of twelve sites are less than 1 ha. Only one middle terrace site (BBK) is considered large. Two large and three medium sites are situated in the alluvial plain.

Rank-size analysis was conducted on the KSTUT Survey data in order to help assess population distribution across the settlement system and to determine how it may have changed through time (Drennan and Peterson 2004; Johnson 1980). The rank-size rule provides a standard measure for assessing the degree of regional integration in a settlement system based on site size relationships. The rank-size rule predicts that in an integrated hierarchical settlement, the size of a given site will be equal to the size of the largest site divided by the rank of the site (all sites being ranked according to site size). Plotting this expected rank-size relationship in log-log scale results in a straight line with slope of −1 (the so-called "log-normal" line). One can plot the actual rank-size data for a given settlement system in log-log scale and make inferences about the degree of integration of sites in that system based on the extent to which the plotted data deviates from the log-normal line. A convex distribution plots above the log-normal line (where either the primary site is smaller than predicted or non-primary sites are larger than predicted by the rank-size rule) and suggests low regional integration and greater site independence. A concave (or "primate") distribution plots below log-normal and is suggestive of early state formation where a dominant primary center has emerged that economically minimizes surrounding settlements.

Due to the multi-component nature of KSTUT sites, rank-size analysis of Metal Age sites was restricted to those sites that do not have a protohistoric component (total of 17 sites). Protohistoric sites were plotted separately. The rank-size plot of sites with bronze and/or iron components produced a clearly convex pattern, which suggests that KSTUT Metal Age sites were relatively autonomous and less dependent politically and economically on each other (Fig. 8*a*). This interpretation is supported by a weak hierarchical expression in KSTUT spatial relationships and heterogeneous site clustering patterns. For example, the middle terrace sites are closely spaced and relatively small compared to upland sites, which tend to be larger and more widely spaced (with emphasis on association with slopes and streams). Of course, a convex distribution might be misleading if a major Metal Age primary center existed outside the KSTUT Survey area, but there is no evidence to support this possibility at present.

In sharp contrast to the Metal Age rank-size distribution, the plot for the eight sites with protohistoric components is markedly concave and strongly suggests a hierarchical settlement pattern in which Chansen had become the dominant center (Fig. 8*b*). The dramatic increase in ceramics at Chansen (covering 92 ha) around A.D. 400 mirrors a pattern across Thailand during the first millennium A.D. That saw the emergence of moated sites and agricultural intensification in lowland areas where wet-rice agriculture is possible (Indrawooth 1999; Kanjanajuntorn 2005; Mudar 1999; Vallibhotama 1996). Chansen has seven smaller sites

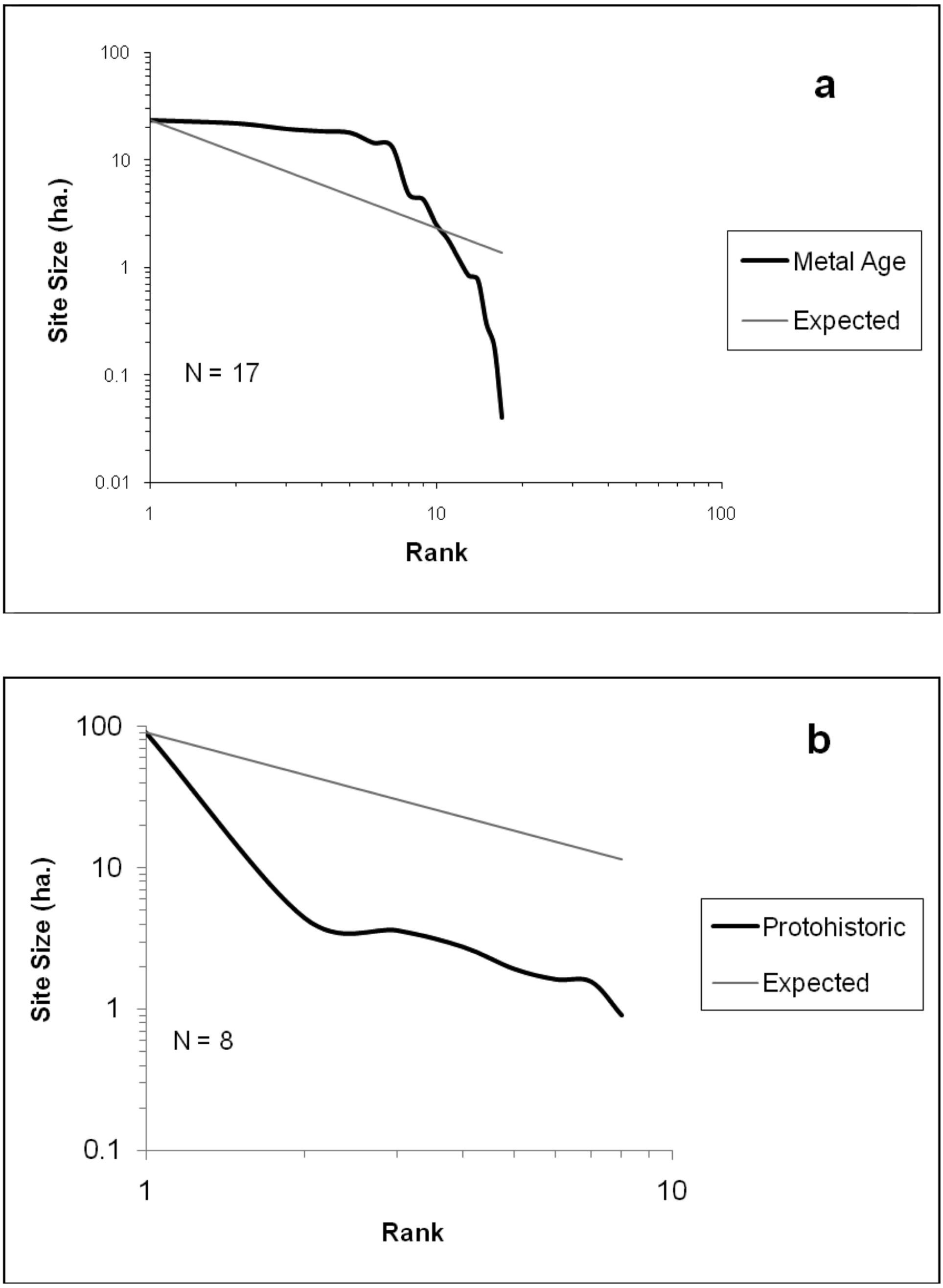

Fig. 8. Rank-size distribution of KSTUT sites: (a) Metal Age, (b) Protohistoric period.

nearby including two medium alluvial plain sites and one small and four medium middle terrace sites. The size and spatial relationships of these seven sites are suggestive of interdependency to a very large Chansen settlement, which can be interpreted as a two-level hierarchy.

Assessment of rank-size distribution, though seldom applied to heterarchy-oriented research elsewhere, has proven to be useful in allowing us to compare general trends among the KSTUT Metal Age and protohistoric site sizes. However, the application raises a couple of issues. First, the multi-component nature of prehistoric sites in central Thailand coupled with limited chronological control hinders fine-grained analysis of distributional changes from phase to phase. It is likely that the area of any sociopolitical group would change over time. Therefore, a refined chronology and much more extensive excavation in the future will no doubt elucidate changes in habitation areas through time. Secondly, the relatively small research area of KSTUT can only provide a window into a bigger issue that has not been adequately addressed in Thailand prehistoric studies—site size variability. With a refined chronology, future analysis of intra-site occupation intensity is clearly needed through expansion of the systematic survey area and test excavations to measure site size and change over time.

Although more research is required, it is possible that some of the different site sizes are the result of seasonal occupation. A settlement system that had seasonal agglomerations of population in large upland sites, with dispersal to small and medium sites in other seasons could account for the non-hierarchical nature of the settlement distribution. Finally, KSTUT data offers some clues regarding different site use patterns across the landscape with strong indications that these were long-term habitats occupied simultaneously, probably by communities of various sizes (Eyre 2006). This evidence could suggest different subsistence practices involving both extensive and intensive agriculture. Future integrated studies of occupation intensity changes at intra- and inter-site levels across diverse landscapes, in combination with palaeoenvironmental and ethnographic data would help to provide a more conclusive picture of KSTUT subsistence patterns and craft production, which in turn will deepen our understanding of central Thailand's prehistoric social complexity.

Metal Age Ceramic Subregions

Ceramic variation analyses of forms and decorations (visible macroscopically) were conducted from the known ceramic sequences of 12 Metal Age sites within the Eastern Chao Phraya River Valley of central Thailand (Table 2) (Eyre 2006 : 260–276). The absence and presence of defined characteristics among these Metal Age assemblages were geographically delineated and later extrapolated for the existence of at least seven distinctive ceramic subregions: BMC (including CH), PN, KWPV, TK, Khao Heng Talat, Khao Samphot, and PMN (Ho 1992; Lertrit 2003*a*, *b*; Natapintu 2003) (Fig. 9). Limited published ceramic chronology hampers in-depth understanding of these ceramic subregions; however, the preliminary analysis offers possible glimpses of their developments. Elephant-hide pottery and forms N1 and B3 are characteristic of Lower Bronze Phase KWPV and SC in the Pasak River Valley (Pigott et al. 1997; Rispoli 1997). Only the odd sherd of elephant-hide pottery has been recorded at BMC and other subregions associated with Lower Bronze Phase occupation. At TK, Lower Bronze ceramics are characterized by red painted ware, which has not been recovered in the BMC and KWPV subregions. Although it appears that at least three ceramic subregions existed in central Thailand east of the Chao Phraya River during the

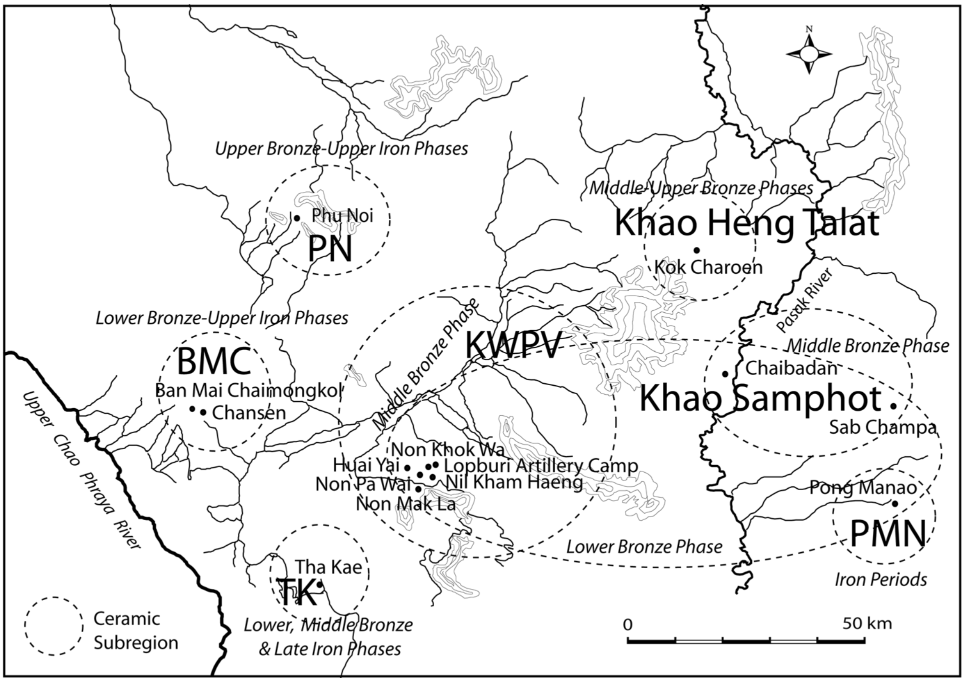

Fig. 9. Proposed ceramic subregions in central Thailand, within Eastern Chao Phraya and Pasak River Valleys.

Lower Bronze Phase, it is unlikely, based on current data, that the three Lower Bronze subregions expanded to the PN or Pasak River Valley region in later phases. New ceramic subregions appear from the Middle to Upper Bronze Phases, the pot form D (or Hole-Mouthed Jar) is distributed widely, but not in the Pasak River Valley (Ho 1992; Rispoli 1997). Yet PN, in the uplands, emerged with its own distinctive ceramic variations of forms K, L, and M dating from the Upper Bronze to the Upper Iron Phases (Natapintu 1997), which thus far appear to be uncommon at BMC, in the KWPV, and at TK. Forms A1, A8, and A9 characteristic of BMC Iron period were not uncovered at PN or KWPV.

BMC Subregion in a Diverse Landscape

Within the KSTUT Survey region, further analysis of stylistic patterning was conducted by determining relationships of shared ceramic attributes using the known sites of BMC and CH to the non-BMC sites (other subregions). A large portion of KSTUT Survey sherds share strong similarities with BMC and CH attributes, including co-occurrences of rim/base types, surface treatments, and surface decorations. These similarities have made it possible to date the KSTUT Survey site occupations and assess the degree of variability in the region and even within sites with confidence. This preliminary study suggests that the survey fell within a single ceramic subregion (hereafter BMC). Interestingly, other proposed subregions within the Eastern Chao Phraya River Valley had parallel diversification of land uses. The KWPV subregion incorporates the middle and high terraces of the Lam Maleng and KWPV Valleys (Mudar 1993, 1995). In fact, the KWPV maintained its ceramic affiliation with Lam Maleng communities even as it focused on metal production. The Lopburi Survey revealed ceramic similarities across various environments in Khao Heng Talat and Khao Samphot subregions (Ho 1992: 40–41).

In addition, notable intra-subregional ceramic variations, within KSTUT diagnostic and non-diagnostic sherds, were documented and defined as *disjunct correlations*. Variant decorations appear to be randomly associated or "mixed and matched" with various types of surface treatment, location of decoration, rim type, or other decoration types (Fig. 10). The variation occurred at different scales: as variation within individual KSTUT sites and as variation between sites. These highly non-standardized ceramic traditions were also observed among KWPV and Lam Maleng assemblages (Mudar 1993: 109; Rispoli 1997: 61). It is clear that there were no strict rules in the KSTUT ceramic typology for associating particular rim types with specific designs. Rather, there appears to have been a repertoire of designs and decorations that the KSTUT potters shared and from which they were free to pick and choose. The disjunct correlation pattern observed could be suggestive of pottery production at multiple locations. Highly individualized expressions within forms within villages might also suggest that pottery production was undertaken by many potters per village. Over time, *disjunct correlations* decreased during the Lower Iron and Late Iron Phases where ceramics show strongest uniformity to BMC and CH.

Shifts in the BMC Ceramic Subregion Over Time

The analysis of the BMC subregion through time reveals a fairly sustained continuation of shared ceramic variability within the subregion from the Bronze through the Iron Phases. Geographic shifts in ceramic subregion are relatively minor and gradual (Fig. 11*a*). Settlements of all three zones show BMC affinities throughout but a strong shift in BMC subregion occurred around the Late Iron Phase at which time there was greater aggregation of Chansen Phase II ceramics in the lowland areas. This integration likely occurred before evidence of centralization during the protohistoric period. Abundant evidence of Chansen Phase II ceramics both at Lam Maleng, KSTUT, as well as TK, suggest that during this time the two or more subregions merged into a single larger subregion (Rispoli 1992: 134–136). Interestingly, the Chansen Phase II ceramics that characterized the Eastern Chao Phraya River Valley region are different from the Pasak River Valley ceramics (e.g., Burnished Black Wares) and the Classic Phimai Phase in northeast Thailand (Lertrit 2002: 124–125; Welch and McNeill 1991: 217). Therefore even if some subregions merged late in the Iron period or had increased interaction, distinct subregions can still be identified.

Although the BMC subregional ceramic domain appears to have been maintained, there were indications of interaction shifts with neighboring subregions over time (Fig. 11*b*). Evidence of these interactions is based primarily on diagnostic forms and decorations pertinent to each phase (Eyre 2006: 501–506). Otherwise, the sample sizes are too small to be conclusive. This could merely be a product of sample bias resulting from incomplete ceramic sequences from PN

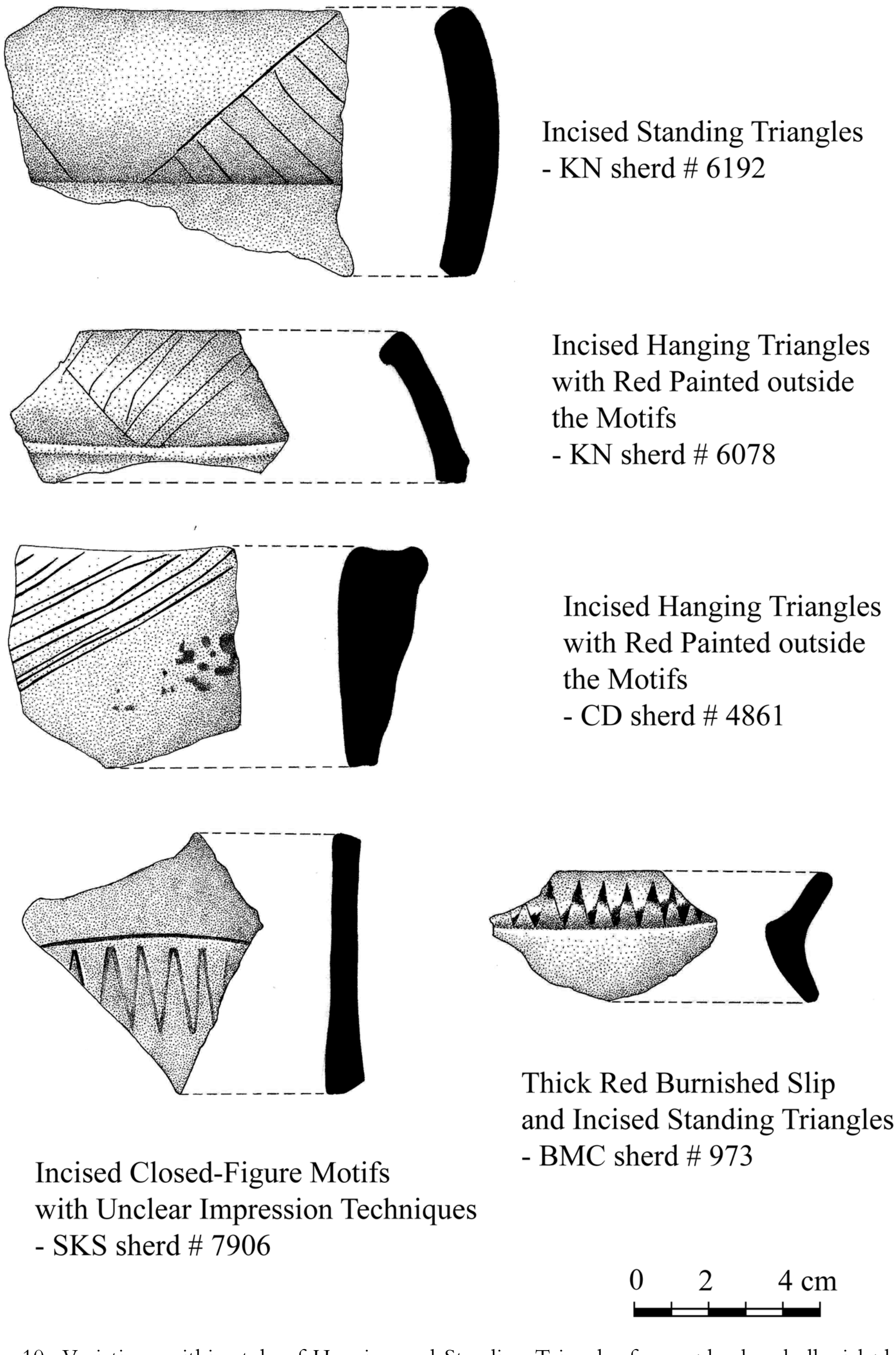

Fig. 10. Variations within style of Hanging and Standing Triangles from upland and alluvial plain sites.

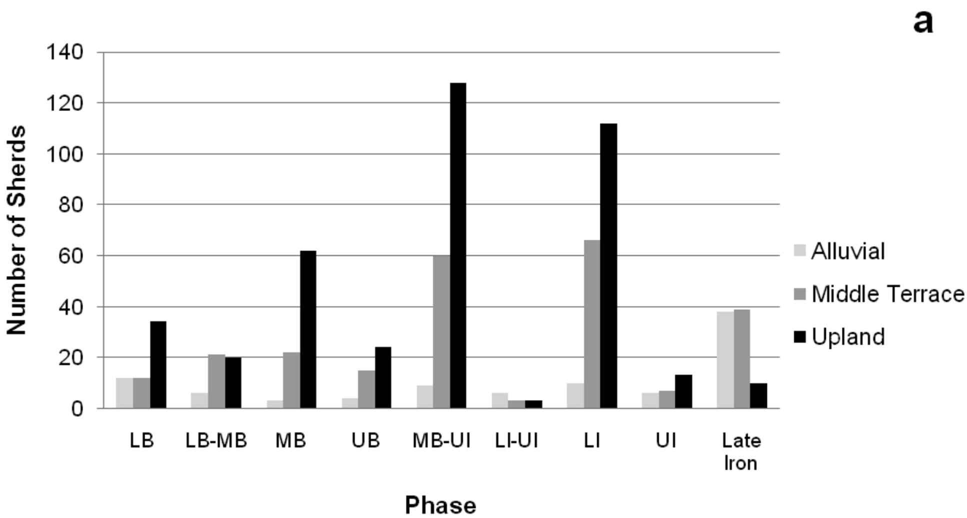

Fig. 11. Chart displays number of survey sherds recovered in each phase and environmental zones: (a) diagnostic ceramics of BMC and Chansen. This analysis is based on a working chronology with loosely defined time periods: LB-MB assignment is based on Incised Lines Filled with Impressed or Incised Motifs and Reserved Decoration. These decorations are commonly found in the BMC subregion, and other central and northeast Thailand sites; roughly 55 percent of MB-UI sherds are assigned based on stylistic similarities, which are shared between BMC and PN; (b) ceramics that are characteristic of other central Thailand sites, e.g., KWPV, PN, SC, and KC.

and the KWPV. During the Lower and Middle Bronze Phases, elephant-hide, TRBS (Thick Red Burnished Slip), and incised lines filled with impressed or incised motifs and reserve decorations—attributes of KWPV subregional ceramics (Rispoli 1997, 2007)—are spottily distributed in the middle terrace and the uplands. However, links between KSTUT alluvial plain sites and the KWPV region as indicated by the presence of the N1/B3 (restricted vessel with carination at shoulder) and elephant-hide sherds at BMC and DM suggest stronger interactions of that lowland portion of the BMC subregion with KWPV at that time. During the Upper Bronze Phase, pot form J (unrestricted vessel and rectangular flat base with basket impressions), which is regionally found at PN, is distributed at five out of seven upland sites. This might indicate an initial change in subregion to subregion interactions in which the upland KSTUT sites interacted more with PN. Continued interactions between BMC upland settlements and the PN subregion are evidenced by many upland sherds of hanging and standing triangle decorations commonly found in the PN Iron period.

Other Evidence of Specialization

Analysis of KSTUT small finds and their associated site types and sizes, despite limited data and temporal control, can enhance our understanding of production, exchange, and economic integration over time. Most of the alluvial plain Metal period artifacts indicate a regional exchange network extending beyond the survey area: stone bracelets possibly came from the KWPV sites (Ciarla 1992; Pigott pers. comm.); the presence of an iron axe and a glass bead were most likely acquired through subregional or regional trade since there is no clear evidence of local production of either object. These exchange items were associated with the large mixed mortuary and habitation site of BMC and the medium habitation site of BMA (Table 3). No ceramic pestle was documented at alluvial plain sites; however, domestic stove fragments were recovered that could have been made locally (Natapintu pers. comm.). The recovery of spindle whorls and stone pestles, commonly found at Dvaravati sites throughout Thailand, indicate local craft production during the protohistoric period (Indrawooth 1999).

Middle terrace artifacts belonging to the Metal periods (e.g., spindle whorls, ceramic pestles, and a ceramic mold for making bronze tools) indicate some level of textile, pottery, and metal production (Table 3). Two ceramic pestles were recovered at medium-sized mixed mortuary and habitation settlements. Like those found in the alluvial plain, marble and shell bracelets and iron tools may have been acquired through subregional or regional networks; these artifacts are associated with both medium and large mixed mortuary and habitation sites. The RK ceramic stove fragments are similar to those found in the lowlands. In the uplands, at least six different kinds of local productions occurred during the Metal Age based on the recovery of fragments of an unfinished stone bracelet, a modified shell, an unretouched flake, as well as polished stone axes, spindle whorls, ceramic pestles, and fragments of tuyères (associated with iron production) (Fig. 12). The majority of polished stone adzes/axes found during the survey were recovered at upland sites. In contrast to the lowlands, all stone bracelets recovered in the uplands were non-marble and spindle whorls are larger in size than those found at lowland sites. The majority of pestles and tuyères come from two large mixed mortuary and habitation sites in the uplands. Exchange items including stone bracelets, a bronze tool, and iron tools are associated with medium and large habitation and mixed mortuary/habitation sites (Table 3). A complete cordi-

Table 3. Types and Numbers of Production or Consumption Artifacts at Small and Medium KSTUT Sites

				STONE				CLAY/CERAMIC				BRONZE	IRON
SITE NAME	ENVIRONMENTAL ZONES	RANK SIZE	TOTAL SMALL FIND	POLISHED ADZE/AXE	BRACELET	MISC	SHELL	SPINDLE WHORLS	PESTLE	STOVE	MISC	TOOL	TOOL
BMA	alluvial	medium	1										1: axe
RK	middle terrace	small	2							2			
KK	middle terrace	medium	1						1				
NYA	middle terrace	medium	5		1	1: sculpture	1: worked	1	1				
NON	middle terrace	medium	3		1: bangle						1: seal		1
SKS	upland	medium	1	1									
SKB	upland	medium	1									1: socketed axe	

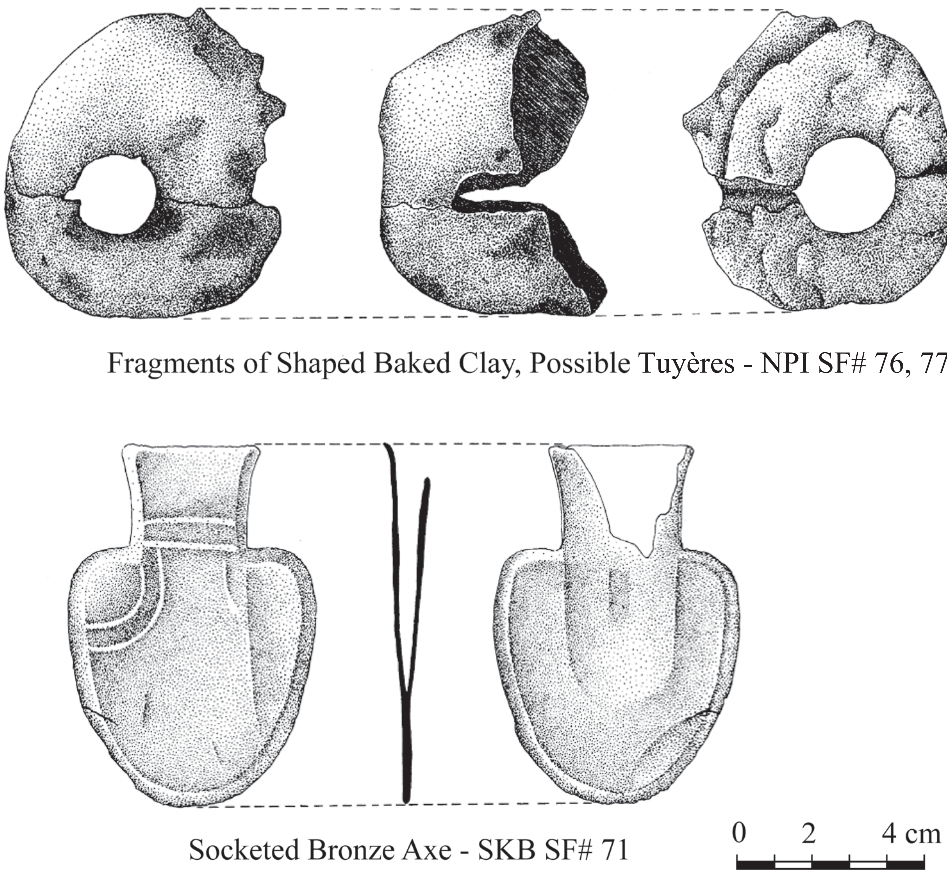

Fig. 12. KSTUT small finds uncovered in the uplands.

form socketed bronze axe, similar to unalloyed cordiform copper-base adze/axes found at KWPV (Pigott et al. 1997 : 130–131), was recovered at a medium-sized habitation settlement (Fig. 12). Although its function remains unknown, this type of artifact is known to have been produced primarily at the site of Nil Kham Haeng.

At this research stage, the fact that evidence for production activities was recovered at eight different middle terrace and upland sites (varying in size and function) could suggest the existence of local production. It is notable that during the Metal Age, the upland settlements appear to have been more active in a variety of productive activities. In terms of exotic artifact distribution, various settlement types and sizes across the landscape evidently participated individually in regional networks beyond the BMC subregion. During the iron age, the alluvial and upland communities were likely integrated in much broader regional networks based on the presence of glass beads and iron tools (Bellina and Glover 2004; Glover 1990; Higham and Thosarat 1998; Pigott et al. 1997 : 139, Fig. 17).

DISCUSSION

The complexity of KSTUT Survey data highlights a need to embrace a broad range of information in determining sociopolitical organization in the Eastern Upper Chao Phraya River Valley. Although hierarchical organizations have been documented during the iron age in parts of northeast Thailand (Higham et al. 1982; Kijngam et al. 1980; Welch and McNeill 1991), the KSTUT and Lam Maleng Survey data suggest an absence of centralized political organization until c. A.D. 400 (Mudar 1993) in this part of Thailand. Two counterpoised mechanisms of power can be inferred from the KSTUT settlement patterns and evidence of economic specialization. While an internally loose and decentralized sociopolitical system incorporating multicenter production endured, the existence of a ceramic subregion indicates a strong socioeconomic connection persisted in binding these settlements together. This distinctive scenario suggests that KSTUT political, social, and economic aspects might not always overlap. Counterbalanced political and economic power is a hallmark of a heterarchical system (Crumley 1995, 2003).

While it is unlikely that the KSTUT Survey boundary captures the entire social system of local Metal Age communities in central Thailand, the KSTUT political economy can be characterized as having heterogeneous and diversified organization based on the evidence of varying site types, sizes, and land uses. These decentralized formations may have supported independent economic networks and fostered political fluidity, stability, and longevity. Heterogeneous and diversified settlement systems have been intensively studied in a protohistoric trade-based state at Kedah, Malaysia (c. A.D. 700–1500) (Allen 1988, 1999). In fact, many forms of sociopolitical organizations existed within Kedah's entity. An upland heterarchy system developed alongside a hierarchical structure formed within the riverine redistributive networks and Kedah's coastal entrepôts. These upland sites maintained a heterarchical formation even as they were key producers and suppliers of agricultural necessities such as dryland rice, millet, and other forest products to hierarchical communities farther downstream for consumption and export. These complex kinds of relationships raise the possibility that hierarchical organization during the protohistoric period in mainland Southeast Asia developed from economic-based interaction rather than sociopolitical exertion (Allen 1999:140).

It might be possible that the central Thailand ceramic subregions represent economic spheres of production and distribution. The BMC, KWPV, and Lopburi ceramic subregions were expansive and fluid multicentric networks possibly incorporating community-based specialization. The site-to-site variation documented within the BMC subregion supports the notion that more than one village made pots and that the subregion was not the result of a trading range of one or two specialized potting communities. That the coherent range of forms and styles encompasses a variety of environmental zones appears to support the likelihood that more than one subsistence strategy was undertaken within these exchange spheres. Economic interaction spheres often are larger than most other types of interaction spheres (e.g., prestige goods and political exchange networks) with the exception of information flow (e.g., Chase-Dunn and Hall 1997; Mann

1986). Further investigation of the relations within this bounded economic network with an emphasis on the nature of ceramic variability is a necessary step towards understanding power dimensions among these Metal Age communities. It is possible that local communities in central Thailand participated to different degrees in exchange networks and that could be suggestive of independent and decentralized socioeconomic networks. Despite some stability within BMC subregion during the bronze and iron ages, the number of subregions in Thailand overall appears to have increased over time since the beginning of the Middle Bronze Phase and there is abundant evidence of interaction among many of those subregions. In the BMC subregion, upland sites seem to have been engaged in more kinds of production than in the lowlands. Upland economic networks grew tighter during the Upper Bronze Phase and became even more intensified during the Iron periods before declining around the Late Iron Phase.

Ceramic subregion is a working concept that must be further tested and refined through time. Future research is needed to clarify the nature, extent, and prevalence of subregional interaction. It is possible that the KSTUT ceramic assemblage may not be the most adequate proxy for Metal Age social complexity in central Thailand. Further technical studies such as xeroradiography and compositional analysis should further elucidate the central Thailand ceramic subregions. For example, the elephant-hide pottery has unusual formation processes whereby the clay is pressed into a coarse basket mold rendering wide and deep basket impressions (Rispoli 1997:65). Based on current data, the technique is rare outside of the KWPV. In northeast Thailand, White also noted that technical choices varied from subregion to subregion (1995:105). It is the realm of different technical choices among neighboring communities that helps to reveal cultural patterning in these pre-state societies (e.g., Pfaffenberger 1992; Stark 1998).

Application of heterarchy in explanatory frameworks to account for the presence of fairly sophisticated bronze and iron production and trade in societies that do not appear to be particularly complex socially, politically, or economically has proven to be a meaningful endeavor. While the limited number of metal artifacts recovered provide but a glimpse into production and trade activities in the surveyed area, nevertheless, several observations can be made. The mold from a middle terrace site of BBK and the tuyères from the upland site of NPI indicate local production of copper-base and iron objects. The cordiform socketed adze/axe from medium upland site of SKB suggests a trade network with the KWPV during the iron age. This evidence of dispersed metal production and non-monopolized trade are consistent with common observations of Metal Age communities in Thailand as being engaged in community-based specialization (Costin 1991; White and Pigott 1996). Recent research has demonstrated that metal-working technology did not originate but rather was introduced into mainland Southeast Asia (e.g., Higham and Higham 2008; Pigott and Ciarla 2007; White and Hamilton 2009). This seems a plausible explanation as to why early prehistoric societies in Thailand do not conform to expectations for hierarchical social dynamics developed from research in parts of the world which saw the evolution of bronze and ironworking. Currently, the link between in situ development of metal production and hierarchy is not apparent. While, the existence and flourishing of metalworking in prehistoric Thailand indicates significant economic and environmental factors to promote the adoption of metalworking technology, the very nature of locally decentralized and fluid socioeconomic organizations might prevent usurpation and establishment of a strong hierarchical development.

CONCLUSION

The KSTUT research demonstrates that paradox in Southeast Asian archaeology is a real phenomenon, therefore great efforts must be made toward developing alternative hypotheses and minimally biased methodologies to produce new data to further test and refine these alternatives. The KSTUT research contributes to the development of a heterarchy-based interpretive methodology and framework to understand Thailand's Metal Age complexity that stresses lateral decentralized integration. KSTUT methodologies emphasized collection of a broad range of data, combined intensive survey and systematically defined ceramic subregions, and sought to minimize biases based on prior expectations in order to produce data that can be used to test a variety of hypotheses. The heterarchy framework enriches our understanding of long-term sociopolitical changes by providing a means to evaluate variations in the recovered data.

KSTUT Survey reveals two key unanticipated characteristics of Metal Age communities in Thailand which consisted of heterogeneous and diversified settlement systems that coincided with strong economic networks. Not until the protohistoric period did an extensive reorganization of the population and hierarchical settlement system occur in the Eastern Upper Chao Phraya River Valley of central Thailand, namely large central sites with associated small sites oriented toward wet-rice lands. Large Metal Age sites existed in non-rice growing areas, and showed no clear spatial or artifactual evidence for political or economic centralization; they may have attained their sizes, in part, due to multiple and long-term functions such as habitation and mortuary practices (White and Eyre in press). Ceramic subregions provide crucial dimensions for elucidating social complexity of prehistoric Thailand. Within the KSTUT, ceramic subregions possibly represent regional economic systems of broad, decentralized and fluid exchange networks that transcended site sizes, types, and locations of settlements and subsistence patterns.

The KSTUT evidence of settlement and economic systems illustrates highly varied and dynamic Metal Age societies. The current data indicate that metal technology may have played a less significant role in the development of social complexity in terms of political or economic centralization than previously assumed. An alternative framework, incorporating heterarchy, brought out these two characteristics that can be further tested to see if they contributed to the distinctive regionality of sociopolitical development in prehistoric Thailand. More research is needed to study transitions from pre–Metal Age to Metal Age societies and to further clarify the relations between diversified subsistence economy, exchange networks, and development of power relations among groups (Burke 2006; Stahl et al. 2008).

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ABSTRACT

Southeast Asia is one major region where applications of sociopolitical frameworks emphasizing progressive development and increasing degrees of social hierarchy have been argued as inadequate for understanding past societies. Settlement systems in Thailand that existed throughout the period of technological change incorporating the bronze and iron ages have not yet been investigated from a heterarchical viewpoint. While reconnaissance and systematic surveys conducted over the past few decades in Thailand have discovered hundreds of prehistoric sites, a recent survey stressing intensive methodologies to test heterarchical and hierarchical frameworks for best fit with settlement patterns in the region of Kok Samrong-Takhli Undulating Terrain (KSTUT) in the eastern side of the Upper Chao Phraya River Valley has revealed unexpected patterns of land use and settlement systems. This article discusses the methodology and results of the KSTUT Survey in central Thailand. A two-stage survey, a reconnaissance survey followed by a 58 km^2 intensive survey, was conducted in order to locate sites across different landscapes, to identify subregional ceramic variation and possibly geographic shifts in ceramic subregions over time, and to determine evidence for economic specialization among sites of varying sizes. The 25 sites dating between 2000 B.C. and A.D. 1000 provide evidence for a prehistoric settlement system emphasizing long-lived, often large, but heterarchically related occupations. Sharp changes including the appearance of site hierarchy occurred rapidly just prior to the protohistoric period c. A.D. 400, about 1000 years later than previously thought. Keywords: social complexity, Metal Age, Thailand, heterarchy, intensive survey, settlement systems.